

Appl. No. 10/667,666  
Amendment dated: February 16, 2005  
Reply to OA of: November 16, 2004

**Amendments to the Specification:**

On page 1, please replace the first full paragraph with the following amended paragraph.

One object of the present invention provides an organic-inorganic hybrid film material consisting of ~~polyamide~~ polyimide and either poly(silsesquioxane) or silicon alkoxide.

Please replace the third full paragraph with the following amended paragraph.

Metal material, ceramic material, polymeric material, and electronic material are four main classes in current material science field. Each material owns its specific properties for certain use. For example, the polymeric material has advantages of its readily processing, robustness, resilience, corrosive-resistance, electrical-insulation, and low cost but has disadvantages of poor heat-resistance and mechanical property. The ceramic material has advantages of stiffness, low activity, thermal stability but has disadvantages of heavy and brittleness. It will develop a new material having new properties if someone ~~[[take]]~~ takes advantages of one material for compensating shortcoming of another material. Such a concept attracts people's attention to further investigate an organic-inorganic material hybrid material.

Please replace the last full paragraph which bridges page 2 with the following amended paragraph.

Conventional composite has a domain in the order of microns to millimeters. In such a composite the organic or inorganic component mainly plays a role for varying a structure or function of the composite. Its preparation mainly comprises a physical blending. Additionally, the hybrid material is prepared by sol-gel or self-assembly

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process to hybridize the organic and inorganic material. For example, incorporation of organic material into inorganic master material will improve the inorganic material's brittleness and could render the inorganic material colors. Alternatively, incorporation of inorganic material into organic master material will improve the organic material's strength, heat-resistance and hygroscopicity. Thus, new material having novel properties will be developed through molecular design.

On page 4, please replace the first full paragraph with the following amended paragraph.

Summary, preparation of low dielectric film and optical waveguide material from poly(silsesquioxane)/polyimide hybrid material has the following questions: (1) evenly dispensing of the organic ~~[[and]]~~ into inorganic materials ~~are poor~~ is difficult and thus easily results in phase separation; (2) only one of organic material ~~[[to]]~~ and inorganic material could be used as a master material due to the ~~invariability of a~~ limited ratio ~~between~~ of the organic material to inorganic material.

Please replace the first full paragraph after the heading "Summary of the Invention" with the following amended paragraph.

One object of the present invention provides an organic-inorganic hybrid film material consisting of ~~polyamide~~ polyimide and either poly(silsesquioxane) or silicon alkoxide.

On page 7, please replace the last full paragraph with the following amended paragraph which bridges page 8.

The term "polyimide" used herein refers to a product obtained from curing the poly(amic acid) as defined above at an elevated temperature then cyclizing the

functional group –NH-CO- with a carboxylic functional group contained in the poly(amic acid). Accordingly, the product from reacting the diamine and the dianhydride refers to “poly(amic acid)” before curing and it refers to “~~polyimine~~” “polyimide” after curing.

On page 14, please replace the first full paragraph after the heading “Example 9” with the following amended paragraph which bridges page 15.

**Preparation of poly(amic) having a theoretical molecular weight of 1000 gram/mole.** 0.569 Grams of 4,4'-oxy-dianiline (ODA) were dissolved in 8.5 g of N,N-dimethylacetamide (DMAc) and stirred for 20 minutes. Then 0.931 g of pyromellitic dianhydride (PMDA) were added slowly and stirred for 4 hours at room temperature. Then 0.509 g of 3-aminopropyl trimethoxy silane (APrTMS) were added. A mole ratio of PMDA: ODA: APrTMS was 3: 2: 2. After [[the]] addition of APrTMS, the reaction was carried out for further 20 minutes to obtain poly(amic acid) solution (B).

On page 15, please replace the first and second full paragraph after the heading “Example 10” with the following amended paragraphs which bridge page 16.

**Preparation of poly(amic) having a theoretical molecular weight of 1000 gram/mole.** 4.10 Grams of 4,4'-oxy-dianiline (ODA) were dissolved in 62.2 g of N,N-dimethylacetamide (DMAc) and stirred for 20 minutes. Then 9.12 g of 4,4-biphenyl dianhydride (BPDA) were added slowly and stirred for 4 hours at room temperature. Then 3.68 g of 3-aminopropyl trimethoxy silane (APrTMS) were added. A mole ratio of BPDA: ODA: APrTMS was 3: 2: 2. After [[the]] addition of APrTMS, the reaction was carried out for further 20 minutes to obtain a solution (D) of 13.6 g of poly(amic acid) in 62.2g of N,N-dimethylacetamide.

**Sol-gel reaction of silicon alkoxide solution and poly(amic acid).** Into the solution (D) of 13.6 g of poly(amic acid) in 62.2g of N,N-dimethylacetamide was added 15.5 g of tetramethoxy silane (TMOS) and then added 8.3 g of deionized water and the

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mixture was stirred at room temperature for 1 hour to hydrolyze the terminal alkoxysilyl group contained in the poly(amic acid). It resulted in a solution of silicon alkoxide-poly(amic acid) hybrid material.

Please replace the last full paragraph on page 16 which bridges page 17 and ends on page 18 with the following amended paragraph.

From the FT-IR spectrum shown in Figure 2, it is found that poly(methyl-silsesquioxane) or silicon alkoxide has been completely reacted, and each peak area varies with its content. From the AFM spectrum shown in Figure 3, it is found that polyimide having lower molecular weight has a better surface flatness, in which Figure 3(a) shows a poly(amic acid) having molecular weight of 1000, Figure 3(B) shows a poly(amic acid) having molecular weight of 5000, Figure 3(c) shows a poly(amic acid) having molecular weight of 1000 without addition of coupling agent. Figure 4 shows a plot of roughness of films vs. poly(methyl-silsesquioxane) content. From Figure 4, it is known that hybrid film obtained from poly(amic acid) having lower molecular weight has an average roughness of less than 1 nm, and the film obtained without using coupling agent exhibits the largest roughness. From SEM spectrum shown in Figure 5, it is known that a hybrid film prepared from poly(amic acid) having higher molecular weight significantly occurs phase-separation in case of reacting with high content of poly(silsesquioxane). It demonstrates that increasing of crosslinking density actually decreases the phase-separation. From Figure 6, it is shown that the refractive index can be controlled by ~~exchanging~~ changing the weight ratio of poly(amic acid) to poly(silsesquioxane). From Figure 7, it is shown that ~~birefractive~~ bi-refractive index will be decreased since addition of inorganic material destroys the ~~arrange~~ arrangement of high molecular. Thus, ~~birefractive~~ bi-refractive index decreases slightly with the increase amount of inorganic material. Figure 8 shows a near IR spectrum of the hybrid film of the present invention. The hybrid film of the present invention shows no absorbance in a frequency range use din optical waveguide and is useful as optical waveguide

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material. From Figure 9, it is shown that a plot of dielectric index vs. content of poly(methyl-silsesquioxane) of the hybrid film is non-linear graph due to its hygroscopic property and film thickness and the dielectric index decreases with increase of inorganic material. From Figure 10, it is shown that addition of inorganic material will increase the heat-resistance of the hybrid film, and the film prepared from poly(amic acid) having higher molecular weight exhibits better heat-resistance than that prepared from poly(amic acid) having lower molecular weight. From Figure 11, it is shown that all hybrid films of the present invention have a pyrolysis temperature of more than 545°C. It demonstrates that the hybrid film of the present invention possesses excellent heat-resistance. Also, a DSC analysis for the hybrid film of the present invention shows no glass transition temperature. Finally, from Figure 12, it is shown that addition of inorganic material will increase stability of the hybrid film.

Please replace the original Abstract with the new Abstract found on a separate page at the end of this paper.